set in examinations, but in many cases they would do little towards helping a student to know the mineral when he saw it, and this after all is what the real student wants. To learn how to worry out for himself that a mineral is probably a felspar is infinitely more valuable as a bit of educational discipline than to be able to write down in an examination the chemical composition of felspars. If only a few of the commoner rock-forming minerals had been treated of, it would have been quite possible in the space available to have given descriptions of the way in which a student must go to work in order to recognize them; but then some minerals must have been omitted that are liable to be "set" in examinations.

There are in the book many little slips, not very serious, which might usefully be corrected when opportunity offers. On p. 28 it should be stated that clay is hydrated. There is hardly reason to say that quartzite has been "almost melted" (p. 42); it is certain that in many cases its hardness is due to the deposition of secondary silica. It would have been as well to give some account of the physical characters of serpentine (p. 43), and greater definiteness of statement as to the minerals by the alteration of which it has been produced. I really hardly know what grounds there are for the statement, on p. 78, that the action of glaciers has had any thing to do with the production of immense perpendicular cliffs of limestone. One would have liked to see a section somewhat nearer the actual thing in the place of our old time-honoured friend the section across the Jura on p. 98. I am not sure, but I fear, that the dissolution of actual chalk in carbonated water would go on slowly (p. 45); freshly precipitated calcium carbonate dissolves fast enough, and is safer for lecture-room experiment. It is not carbonate of iron that gives a bluish-grey tint to rocks, as stated on p. 47. In chapters vii. to xi. it would seem that we have a much closer representation of the author's actual teaching than in the earlier part of the book; there is much life and brightness about them; and, while they are full of matter, it is presented in an attractive form. It would have been well to give distinctly the two main points of difference between Conchifers and Brachiopods on p. 113. The only character mentioned is that the latter are equilateral. The Trilobite on Fig. 110 is not a Paradoxides. The section on Fig. 139 is misleading; the Permian scarp nowhere towers above the Penine ridge in the way represented. It would certainly be desirable to add a word about the Alpine Trias on p. 169. The position of the siphuncle in Goniatites is incorrectly stated on p. 181. By a curious slip the Portland Beds get the credit of Mammalian remains on p. 193. In the figure of Inoceramus, on p. 213, the cartilage-pits of the hinge are described as teeth. In the notice of the Forest Bed, on p. 226, room might be found for a word about the Arctic Freshwater Bed.

After all this fault-finding, it is a pleasure to be able to call attention to the excellent character of the illustrations: they are numerous, well chosen, and admirably executed; the figures of fossils deserve special praise. The geological map of the British Isles will be most useful. It is not crowded, and the clear transparency of the colours is such as till lately was unknown in English chromolithography. The book belongs to a class that I have no great love for, but it is distinctly good of its kind; and it will prove useful in the hands of a teacher who knows how to dilute and season the condensed food which it offers, and whose aim, like the author's, is not merely to get his students through an examination, but to educate them and imbue them with the scholar's disinterested love for learning. A. H. GREEN.

ELECTRO-METALLURGY.

The Art of Electrolytic Separation of Metals, &c. (Theoretical and Practical). By G. Gore, LL.D., F.R.S. *Electrician* Series. (London: The *Electrician* Publishing Co., 1890.)

A Treatise on Electro-Metallurgy. By W. G. McMillan, F.I.C., F.C.S. Griffin's Scientific Text-books. (London: Charles Griffin and Co., 1890.)

ANY metallurgical process which reduces the cost of production as compared with older processes for effecting similar results must of necessity prove of great commercial importance. This is especially the case in places where labour is dear and unskilled, and fuel and refractory materials both scarce and costly—perhaps, even, absolutely unobtainable. If, too, the new process enables a metal to be produced, as in the case of copper, which possesses superior quality to the metal produced by the older process, such a metal will command a higher market price, and the use of the new process is consequently attended with important commercial advantages.

Such an improvement over ordinary metallurgical processes has been effected in recent years by the gradual introduction of electrolytic methods. They have not, however, made the rapid progress which was at one time anticipated, and at present are practically only of importance in the metallurgy of copper. There are many reasons for this. The tendency to-day is to endeavour to increase to its maximum the daily output of existing works, provided the product already attainable is of fair quality, rather than to lay down new plant, which, although it might produce a metal of greater purity, would be severely handicapped by the slowness of the work and smallness of the output as a return for the capital invested. It is in this respect that electrolytic methods for the preparation of the ordinary commercial metals fail to give satisfactory results. It is true that in the cases of gold and silver this objection does not to so large an extent apply, but, unfortunately, other circumstances have also to be considered. The metallurgy of the precious metals is for the most part effected in the immediate neighbourhood of the mines, and these, in turn, are usually situated in out-of-the-way districts. Miners, too, and mill-men are generally but slightly acquainted with a knowledge of matters pertaining to electrolytic methods, and comparatively little attention has therefore been directed in the past to the treatment of the ores of the precious metals by such methods. There can, however, be but little doubt that in the near future this will cease to be the case, and that by the improvement of known methods, and by devising new ones, electrolytic methods will attain a degree of commercial importance which at present can hardly be foreshadowed. Any sound contribution to the literature of the subject which is likely to assist in this development

© 1891 Nature Publishing Group

of metallurgical processes thus becomes of much importance. We record, therefore, with pleasure, the appearance of a manual by Dr. Gore, devoted to electro-metallurgy proper, which is likely to prove of much use in the spread of the theoretical knowledge so requisite for industrial success. The author gives much attention to this portion of the subject, but in view of the claim "that this book is written to supply a want," it is to be regretted that fuller details are not forthcoming as to the practical working of the processes, though such information as is given is well and clearly put. The greater part of it, however, has already appeared elsewhere. In the case of copper, for instance, if the working arrangements are faulty, the mud liberated on the solution of the impure copper may be deposited again on the cathodes; the tank solution, too, may vary in density, and the working become irregular with a consequent irregularity in the character of the metal produced. Here, again, excessive rapidity, fatal to the purity of the product, is very common, the result being that in the majority of instances it is necessary to melt the deposited copper, thus introducing sources of error which it is one of the main objects of the process to avoid. The incidental collection of the gold and silver in copper submitted to such a refining process may occasionally cease to be an incident and become the main object of the process, ores of gold and silver being intentionally added in the previous smelting operations.

The difficulty of obtaining admission to works employing electrolytic refining methods, which the author himself laments, is so great, that it is with all the more regret that we have to call attention to this want of fuller details as to the more recent modifications of working adopted in this country and elsewhere. The text-book is otherwise an excellent one.

The term "electro-metallurgy" has been generally applied in the United Kingdom to all operations in which a metallic deposit is produced by means of electrolysis, however small the scale of production may be. Such a designation of the art is much too broad, and it would be better to limit the use of the term "electro-metallurgy" to those processes which are employed on a large scale for the purpose of extracting or refining metals, as distinguished, that is, from ordinary galvanoplastic methods.

This criticism applies to the "Treatise on Electro-Metallurgy," by Mr. W. G. McMillan, the greater part of which relates to galvanoplastic methods proper. Metallurgical processes, however, are also considered, though but little space is given to them; and a chapter, which might well have been a longer one, is devoted to electrolytic methods of assay.

Dr. Gore, after giving a brief historical sketch of the subject, passes to a consideration of the theory of electrolysis, which is considered at some length, useful tables being also given. The mode of establishing an electrolytic refinery, together with the plant required for this purpose, is next considered, and in addition to an account of the various types of dynamo-electric machines in use for electrolytic purposes, brief descriptions are also given of the various electro-metallurgical processes which have been from time to time proposed.

In Mr. McMillan's treatise, an historical introduction to the subject of electro-metallurgy is given, accompanied by a theoretical consideration of the question. A chapter is devoted to the "sources of current," and in a series of other chapters the art of electro-plating is described. Another chapter refers to electro-typing, and others relate to the electro-deposition of the various metals and some alloys. Electro-metallurgical processes proper are also considered, together with methods of assay, and a glossary is added of substances commonly employed in electro-metallurgy. Forty-three useful tables are given as addenda, and the printing is clear and distinct.

We can recommend both these manuals, not only to students, but also to those who are interested in the practical application of electrolytic processes.

OUR BOOK SHELF.

Leçons sur l'Électricité professées à l'Institut Électro-Technique Montefiore annexé à l'Université de Liége. Par Eric Gerard. Tome II. (Paris: Gauthier-Villars et Fils, 1890.)

THIS volume completes the work the first part of which has been already noticed in NATURE (vol. xlii. p. 219). In the first volume, the general principles of electricity and magnetism and the theory of dynamo-electric machinery were explained; the volume now before us contains a very clear and full account of the most important industrial applications of electricity. The principal subjects discussed in this volume are: methods of distribution in electric lighting; transformers, and meters; the insulation of electric light cables; electric motors, both with constant and alternating currents; the transmission of power; electric railways and tramways; descriptions of the various kinds of incandescent and arc lamps; photometry; electro-metallurgy, including the deposition of metals from solutions and fused salts; electric welding. All these subjects are clearly explained, and generally illustrated by instructive diagrams and figures; the book is well up to date, and should prove of great service to students of electric technology. The only fault we have to find with it is that it contains no references which would enable the student to consult for himself papers in which the various processes are described more fully than is possible in a text-book of moderate size. This omission, though exceedingly common in French treatises, is one which we think is greatly to be deplored: in the first place, it leaves the student at the mercy of the author, for, if he does not understand the explanations in the text-book, he does not know where to turn for another with which he might have a better fate; and secondly, we hold that the habit of consulting papers in the Transactions of learned Societies and scientific journals is a most valuable one for the student to acquire, and that it has no chance of developing unless text-books contain references to such papers. J. J. T.

Fathers of Biology. By Charles McRae, M.A., F.L.S. (London: Percival and Co., 1890.)

STUDENTS of anatomy and physiology, as the author of this little book points out, are apt to suppose that the facts with which they are now being made familiar have all been established by recent observation and experiment. There could not be a greater mistake. Biology is a science of "venerable antiquity," and the way was prepared for modern discoveries by the labours of many patient and far-seeing investigators. In the present volume Mr. McRae has sought to illustrate this by sketching the biological work of Hippocrates, Aristotle, Galen, Vesalius, and Harvey. He could not have selected five inquirers better suited for his purpose; and within the limits he has allotted to himself he has succeeded admir-

© 1891 Nature Publishing Group